

# Operating instructions

## Stationary solar vented lead-acid batteries

## OPzS.solar & OPzS.block.solar

Assembly and CE-marking by.....

Date.....

Commissioning by .....

Date.....

Number of cells/blocks: .....

Type: .....

### WARNINGS



Observe operating instructions and position them within sight of the battery! Work only on batteries under instruction of skilled personnel!



When working on batteries wear safety glasses and protective clothing! Comply with accident prevention rules as well as with DIN VDE 0510, VDE 0105 part 1!



No smoking! Do not expose the battery to an open flame, a glowing fire or sparks as explosion and fire hazards exist.



Acid splashes in the eyes or on the skin must be washed out or off with plenty of water. Then see a doctor immediately. Clothing exposed to acid should be washed out with water without delay.



Dangerous voltages!



The electrolyte (diluted sulphuric acid) is extremely corrosive.

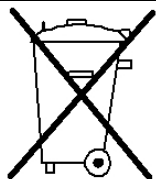


Block batteries or cells are heavy! Ensure secure installation! Only use suitable transport equipment!



Explosion and fire hazard due to explosive gases escaping from the battery. Caution! Metal parts of the battery are always live; therefore do not place items or tools on the battery! Avoid short circuits!

**Usage of the battery which does not comply with the OPERATING INSTRUCTIONS, repairs carried out with spare parts not approved by the manufacturer, use of additives in the electrolyte or unauthorised interference with the battery will invalidate any claim for warranty.**



Used batteries with this symbol are reusable goods and must be returned to the recycling process or must be disposed in accordance with the rules of the country concerned.



### 1. Commissioning of filled and charged batteries

Before commissioning all cells/blocks must be inspected for mechanical damage. Assemble the cells/blocks in accordance with their polarity. If necessary, the contact surface of the poles and the connectors has to be cleaned. The connectors have to be firmly seated by tightening the terminal screws with a torque of  $22 \pm 1$  Nm. The distance between block batteries and cells should be 10 mm in an installation. Observe the Installation Instruction. Check the electrolyte level in all cells. If necessary top up with purified water as specified under DIN 43530 part 4 all cells having lower level of electrolyte. Be aware that the electrolyte level will increase during charging. during charging. Connect the battery to the DC power supply, with the charger switched off, battery fuses removed

and the load disconnected, ensuring that the polarity is correct: Positive terminal of the battery to the positive terminal of the charger. Multipole cells have to be connected using all poles with same diameter and length of connectors. Switch on the charger and charge as per point 2.3.

In case of alternative power supplies like solar photovoltaic installations or wind turbines (point 2.3), all cells of the battery have to be fully charged until the absolute deviation of the voltages per cell is less than 1 % and the density of the electrolyte has reached the nominal value according to the specification. No load has to be connected to the installation until the battery is fully charged.

### 2. Operation

At installation and operation of stationary batteries for solar applications the standard EN 50 272-2 has to be observed.

Solar block batteries and cells should always be operated with charge controllers and deep discharge protection. Any exposure to direct sunlight as well as any change of ambient temperature  $>10$  K should be avoided.

#### 2.1. Operation modes standby and buffer

In this case the load, the DC power supply and the battery must be connected permanently in parallel. Thereby the charging voltage is the operational voltage of the battery and also the system voltage.

a) During standby operation (float) the DC power supply must be always able to provide the maximum load current and the battery charging current. The battery only supplies current, if the DC power supply fails. The charge voltage at  $20^{\circ}\text{C}$  must be set for OPzS.solar  $\pm 1\%$  measured at the batteries terminals.

b) During buffer operation the DC power supply is not always able to provide the maximum load current. The load current temporarily exceeds the rated current of the DC power supply. During this time the battery supplies current. The battery is not always fully charged. Depending on the load, the charge voltage should be set at  $(2.25 \text{ to } 2.30 \text{ V}) \times \text{number of cells}$ .

#### 2.2. Discharge

The batteries should not be discharged below the nominal capacity and final voltage per cell as indicated in the technical specification. Deep discharges of more than 80 % of the nominal capacity have to be avoided as the life time of the batteries will be reduced.

**Batteries have to be recharged immediately after a partial or complete discharge but at least within a period of one week up to 4 weeks to 100 %.**

To prevent electrolyte stratification, an equalizing charge must be carried out according to operating instructions at  $\text{DOD} > 30\%$   $\text{C}_{10}$  per day or batteries with electrolyte circulation have to be used.

### 2.3. Charging with external charger

Charging must only be carried out with direct current. Chargers with IU-, IUI- or W-characteristics according to DIN 41773, DIN 41776 and DIN 41774 may be used.

#### 2.3.1. IU (or IUI) characteristics

Starting with a given initially constant charging current ("I") the cell or battery voltage reaches the given final value which depends on the charging requirement by the application. The charger automatically switches then to constant operating voltage ("U"). As long as the final voltage is not reached, the charging current is limited by the charger only. Typical values for constant currents are 0.5 to 2.0 times I<sub>10</sub>. Typical constant voltages are 2.23, 2.25, 2.30, 2.40 V/cell. The different voltages are given by the application. The IUI characteristic provides a switching point after a higher first constant voltage to operating voltage.

#### 2.3.2. IUI characteristics

This characteristic is a very effective method in order to recharge batteries in short time and to crack sulphations. At first, an IU characteristic is applied to the battery. After a given time held out at constant voltage, the charging method is then extended by using a reduced constant current ("I"). This current is limited to 5 A/100 Ah C<sub>10</sub>. The cell or battery voltage reaches values between 2.60 and 2.75 V/cell. Check if loads have to be disconnected before, in order to prevent damage. On exceeding the maximum temperature of 55°C/131 F, the charging has to be either stopped or proceed with reduced current or be switched to float charge as per item 2.3.3 in order to allow the temperature to drop. The fully charged state is reached, when the cell voltages have not risen for a period of 2 h.

#### 2.3.3. Float charge (float voltage)

A battery is float charged, when the electrodes are sufficiently polarized in that quantity that the floating current compensates the self discharge rate of the battery. A fully charged battery remains at 100 % SOC while being floated. The float voltage depends on acid density. Please take the values from following table:

| Floating voltage  | Battery type |
|-------------------|--------------|
| 2.23 V/cell ± 1 % | OPzS.solar   |

### 2.4. Charging with alternative power supply

When using an alternative power supply, the battery charger is not always able to supply the maximum load current. The load current can exceed the nominal current of the battery charger. The battery supplies power during this period and the battery will not fully charged. The charge voltage has, therefore, to be set at 2.23 - 2.35 V per cell ±1% x number of cells.

At regular discharges of approx. 0.2 x C<sub>10</sub> a charging voltage of 2.30 V to 2.35 V per cell has to be used. At regular discharges from 0.2 to 0.3 x C<sub>10</sub> the charging voltage should be 2.35 V to 2.40 V per cell.

In accordance with item 2.5 the charging time at those increased voltages shall be limited to maximum 72 h. If no discharge follows then switch to standby operation.

At standby operation without cycling the batteries should be operated at float charge with 2.23 V/cell ± 1 % per cell.

After deep discharge or after inadequate recharging an equalizing charging as per item 2.5 is necessary.

### 2.5. Equalizing or boost charge

Charging method with increased gassing activity at higher cell voltages (>2.33 V/cell), done with either increased constant voltage (e.g. 2.33 to 2.40 V/cell) or constant current. The application of this method shall be time (max. 72h) and temperature (max. 55°C (131 °F)) limited. Please take the values from following table:

| Charging characteristics | Maximum current in A / 100 Ah C <sub>10</sub> | Voltage per cell |
|--------------------------|-----------------------------------------------|------------------|
| I                        | 5.0                                           | 2.60 - 2.75      |
| W                        | 7.0                                           | 2.40             |
|                          | 3.5                                           | 2.65             |

On exceeding the temperature maximum, the charging must either be stopped or proceeded with reduced current or be switched to float charge to allow the temperature to drop. The equalizing charge, if executed with constant current is completed, when the individual cell voltages does not increase longer within 2 hours.

### 2.6. Ripple currents

During recharging up to 2.40 V/cell the RMS value of the AC ripple current may reach temporarily max. 20 A/100 Ah C<sub>10</sub>. After recharging and at standby (float) or buffer operation the RMS value of the ripple current must not exceed 5 A/100 Ah C<sub>10</sub>.

### 3. Battery temperature and related charging voltage

All technical data refer to the nominal temperature of 20°C (68 °F). The ideal operating temperature range is 20 °C ± 5 K (59 °F to 77 °F). The recommended operating temperature range is 10 °C (50 °F) to 30 °C (86 °F). Higher temperatures reduce the working life. Lower temperatures reduce the available capacity. Exceeding the temperature limit of 45 °C (113 °F) up to 55 °C (131 °F) is acceptable only for short periods. Exceeding the temperature limit of 55 °C (131 °F) is not permissible. A temperature-related adjustment of the charging voltage within monthly averaged battery temperature of 10 °C (50 °F) to 30 °C (86 °F) is not necessary. Below 10 °C (50 °F) in the monthly average the charging voltage should be increased (-0.003 V/cell K) for a faster recharging. Above 30 °C (86 °F) in the monthly average voltage may be reduced (-0.003 V/cell K) to reduce water decomposition and corrosion.

### 4. Electrolyte

The electrolyte is diluted sulphuric acid. The rated specific gravity of the electrolyte in the fully charged state is based on 20 °C (68 °F) and the "MAX" electrolyte level with a maximum deviation ± 0.01 kg/l. The rated specific gravity is printed on every type label. Higher temperatures reduce the specific gravity of the electrolyte, lower temperatures increase it. The temperature correction factor is -0.0007 kg/l per K.

Examples: Electrolyte specific gravity 1.23 kg/l at +35 °C (95 °F) corresponds to 1.24 kg/l at +20 °C (68 °F). Electrolyte specific gravity 1.247 kg/l at +10 °C (50 °F) corresponds to 1.24 kg/l at 20 °C (68 °F).

### 5. Maintenance

To avoid leakage currents and the associated risk of fire keep the battery dry and clean. Cleaning with clear water, no solvents, and no detergents. Avoid electrostatic charges. If the electrolyte level has dropped to the „MIN“ mark, purified water as specified under DIN 43 530 Part 4 (maximum conductivity 30 µS/cm) must be used to top up the electrolyte level to the „MAX“ mark.

To be measured and listed every 6 months:

- battery voltage
- the voltage of some cells/block batteries (pilot cells)
- the temperature of the electrolyte in some cells/block batteries (pilot cells).

Every 12 months:

- The voltages and densities/temperatures of the electrolyte in all cells/blocks have to be measured and listed.
- Connectors, racks and ventilation have to be visually checked and restored if necessary.

Should the float charge voltage in single cells deviate more than +0.10 V or -0.05 V from the average value (see item 2.3.3), the customer service should be called.

### 6. Testing

Tests must be conducted according to DIN 43 539 Part 1 and 4 and IEC 60896 - 11. Special test instructions, e. g. to prove operational safety in accordance with DIN VDE 0107 and DIN VDE 0108 must be observed.

### 7. Storage and taking out of operation

If filled lead acid accumulators are to be taken out of operation for a longer period of time, they must be placed fully charged in a dry, frost-free room. To avoid damage periodical equalising charges (every 6 weeks) or permanent float charging have to be made.

### 8. Transport

OPzS.solar block batteries and cells are protected against short-circuit. They are not subject to the German Regulations on Dangerous Goods carried on road and railway (GGVS, GGVE, ADR), if they show no damage, are protected against sliding, falling over and damaging and are piled up on pallets appropriately (ADR, Annexe A, Chapter 3.3, Special Provision 598). These cells/batteries are dangerous goods on sea and air transport. Declaration and packaging must comply with the requirements of IMDG-Codes or IATA-DGR. Cells/batteries without electrolyte are generally no dangerous goods on all kinds of transportation.

## 9. Technical data

| MOLL OPzS.block.solar       |                        |                         |                         |                         |                          |                          |                          |                         |                         |              |             |              |                       |                          |  |
|-----------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------------|--------------|-------------|--------------|-----------------------|--------------------------|--|
| Type                        | C <sup>1 h</sup><br>Ah | C <sup>10 h</sup><br>Ah | C <sup>20 h</sup><br>Ah | C <sup>72 h</sup><br>Ah | C <sup>100 h</sup><br>Ah | C <sup>120 h</sup><br>Ah | C <sup>240 h</sup><br>Ah | R <sub>i</sub> 1)<br>mΩ | I <sub>k</sub> 2)<br>kA | Length<br>mm | Width<br>mm | Height<br>mm | Weight<br>(dry)<br>kg | Weight<br>(filled)<br>kg |  |
| U <sub>e</sub> [V per cell] | 1.65                   | 1.80                    | 1.80                    | 1.80                    | 1.80                     | 1.80                     | 1.80                     |                         |                         |              |             |              |                       |                          |  |
| 12 V 1 OPzS.block.solar 70  | 32.3                   | 56.2                    | 63.8                    | 72                      | 72.8                     | 73.3                     | 75.1                     | 19.20                   | 0.64                    | 272          | 205         | 385          | 29.5                  | 41.0                     |  |
| 12 V 2 OPzS.block.solar 140 | 62.3                   | 108                     | 122                     | 137                     | 139                      | 139                      | 144                      | 9.60                    | 1.28                    | 272          | 205         | 385          | 38                    | 47.6                     |  |
| 12 V 3 OPzS.block.solar 220 | 96.9                   | 168                     | 191                     | 216                     | 218                      | 219                      | 225                      | 6.40                    | 1.92                    | 380          | 205         | 385          | 51                    | 69.4                     |  |
| 6 V 4 OPzS.block.solar 290  | 129                    | 225                     | 254                     | 288                     | 291                      | 292                      | 300                      | 2.40                    | 2.56                    | 272          | 205         | 385          | 33                    | 46.5                     |  |
| 6 V 5 OPzS.block.solar 360  | 161                    | 281                     | 318                     | 360                     | 364                      | 366                      | 374                      | 1.92                    | 3.20                    | 380          | 205         | 385          | 41.7                  | 60.4                     |  |
| 6 V 6 OPzS.block.solar 440  | 193                    | 337                     | 382                     | 432                     | 437                      | 440                      | 451                      | 1.60                    | 3.84                    | 380          | 205         | 385          | 48.5                  | 66.5                     |  |

| MOLL OPzS.solar                |                        |                         |                         |                         |                          |                          |                          |                         |                         |              |             |              |                    |                          |
|--------------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|-------------------------|-------------------------|--------------|-------------|--------------|--------------------|--------------------------|
| Type                           | C <sub>1 h</sub><br>Ah | C <sub>10 h</sub><br>Ah | C <sub>20 h</sub><br>Ah | C <sub>72 h</sub><br>Ah | C <sub>100 h</sub><br>Ah | C <sub>120 h</sub><br>Ah | C <sub>240 h</sub><br>Ah | R <sub>i</sub> 1)<br>mΩ | I <sub>k</sub> 2)<br>kA | Length<br>mm | Width<br>mm | Height<br>mm | Weight<br>(dry) kg | Weight<br>(filled)<br>kg |
| U <sub>e</sub><br>[V per cell] | 1.65                   | 1.80                    | 1.80                    | 1.80                    | 1.80                     | 1.80                     | 1.80                     |                         |                         |              |             |              |                    |                          |
| 4 OPzS.solar 290               | 99.8                   | 201                     | 232                     | 278                     | 285                      | 286                      | 295                      | 0.95                    | 2.16                    | 105          | 208         | 420          | 12.5               | 17.0                     |
| 5 OPzS.solar 370               | 127                    | 257                     | 298                     | 358                     | 366                      | 369                      | 379                      | 0.76                    | 2.70                    | 126          | 208         | 420          | 15.2               | 21.0                     |
| 6 OPzS.solar 450               | 156                    | 317                     | 368                     | 444                     | 454                      | 458                      | 470                      | 0.63                    | 3.24                    | 147          | 208         | 420          | 17.8               | 25.0                     |
| 5 OPzS.solar 490               | 211                    | 371                     | 414                     | 475                     | 488                      | 496                      | 528                      | 0.70                    | 2.90                    | 126          | 208         | 535          | 20.0               | 27.0                     |
| 6 OPzS.solar 620               | 263                    | 468                     | 522                     | 604                     | 620                      | 628                      | 669                      | 0.58                    | 3.48                    | 147          | 208         | 535          | 22.8               | 32.0                     |
| 7 OPzS.solar 720               | 306                    | 543                     | 606                     | 700                     | 718                      | 729                      | 777                      | 0.50                    | 4.06                    | 168          | 208         | 535          | 26.4               | 37.0                     |
| 6 OPzS.solar 930               | 359                    | 670                     | 752                     | 900                     | 933                      | 944                      | 976                      | 0.47                    | 4.32                    | 147          | 208         | 710          | 32.7               | 46.0                     |
| 8 OPzS.solar 1300              | 494                    | 932                     | 1,044                   | 1,260                   | 1,300                    | 1,308                    | 1,365                    | 0.35                    | 5.76                    | 215          | 193         | 710          | 44.6               | 64.0                     |
| 10 OPzS.solar 1510             | 589                    | 1,090                   | 1,226                   | 1,468                   | 1,510                    | 1,536                    | 1,588                    | 0.28                    | 7.20                    | 215          | 235         | 710          | 54.3               | 75.9                     |
| 12 OPzS.solar 1840             | 714                    | 1,320                   | 1,490                   | 1,792                   | 1,840                    | 1,860                    | 1,934                    | 0.23                    | 8.64                    | 215          | 277         | 710          | 63.4               | 89.7                     |
| 12 OPzS.solar 2250             | 882                    | 1,670                   | 1,866                   | 2,181                   | 2,250                    | 2,280                    | 2,397                    | 0.22                    | 9.18                    | 215          | 277         | 855          | 75.4               | 110.0                    |
| 16 OPzS.solar 2860             | 1,139                  | 2,130                   | 2,380                   | 2,779                   | 2,860                    | 2,904                    | 3,024                    | 0.17                    | 12.24                   | 215          | 400         | 815          | 117                | 150.0                    |
| 20 OPzS.solar 3750             | 1,470                  | 2,780                   | 3,100                   | 3,643                   | 3,750                    | 3,804                    | 3,984                    | 0.14                    | 15.30                   | 215          | 490         | 815          | 127                | 187.0                    |
| 22 OPzS.solar 4130             | 1,617                  | 3,060                   | 3,420                   | 4,003                   | 4,130                    | 4,188                    | 4,392                    | 0.12                    | 16.83                   | 215          | 580         | 815          | 141                | 205.0                    |
| 24 OPzS.solar 4710             | 1,814                  | 3,470                   | 3,880                   | 4,564                   | 4,710                    | 4,776                    | 5,016                    | 0.11                    | 18.36                   | 215          | 580         | 815          | 146                | 218.8                    |
| 26 OPzS.solar 4880             | 1,911                  | 3,620                   | 4,040                   | 4,737                   | 4,880                    | 4,956                    | 5,184                    | 0.10                    | 19.97                   | 215          | 580         | 815          | 156                | 231.0                    |

1), 2) - R<sub>i</sub> and I<sub>k</sub> according to IEC 60896-11

Reference temperature for all data is 20 °C (68 °F). The manufacturer reserves the right to alter technical specifications.

1,2 ) internal resistance and short circuit current according to IEC 60896-11

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